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(54) Device for optically detecting the presence of an object

(57) An optical device for detecting the presence of an object (16) at a control station (15) located along a path (P) of the object (16); the device employs an optical fiber (5) having two ends (6, 7), a CCD sensor (8), and an electronic control unit (10) connected to the CCD sensor (8); a first end (6) of the optical fiber (5) is so located at the control station (15) as to face the path (P) of the object (16), and a second end (7) is connected directly to a photosensitive surface (9) of the CCD sensor (8).

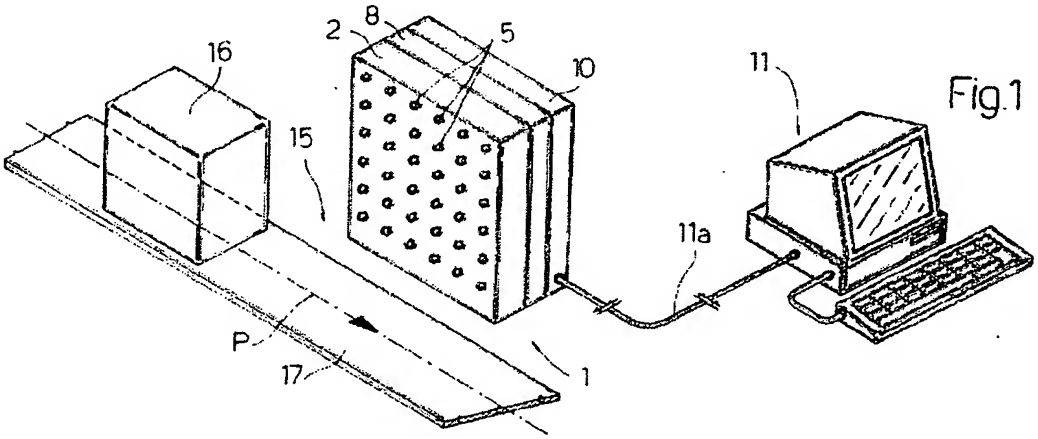

Fig.1

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Description

[0001] The present invention relates to an optical presence detecting device.

[0002] The present invention may be used to advantage for detecting the presence of an object at a control station located along a path of the object itself, and in particular for detecting the presence of cigarettes at a control station located along a path of single or groups of cigarettes, in particular through a cigarette packing machine.

[0003] On cigarette packing machines, a group of cigarettes is first formed, normally comprising three superimposed layers of 7-6-7 cigarettes respectively, and which is fed to a succession of packing wheels. Before performing any of the packing operations, however, it is common practice to perform on each group of cigarettes a series of checks, including detecting the presence of all the cigarettes in the group.

[0004] This is known to be done using a device of the type described in US Patent No. 5,235,649 (or in the corresponding EP Patent No. 518,141), which employs an optical-fiber bundle, wherein a first end of each optical fiber is so positioned as to face, at a control station, the tip of a respective cigarette in the group for examination, and a second end of each optical fiber is connected optically to the lens of a CCD television in turn connected to a digitizing board of a monitoring computer.

[0005] In actual use, each group of cigarettes is fed into the control station, where the camera picks up an image of the tips on one side of the group; the digitizing board connected to the camera digitizes the image; and the computer acquires the digitized image from the digitizing board in the form of a matrix of brightness values, and processes the image to determine the presence or absence, and possible also the fill density, of each cigarette.

[0006] Devices of the above type are fairly expensive, by requiring a television camera with a respective optical assembly, a digitizing board, and a monitoring computer, and are even more expensive when high-speed operation is called for, as in the case of modern cigarette packing machines capable of producing as many as ten packets of cigarettes a second. Consequently, known devices of the above type are normally only justified when used to determine both the presence and the tip fill density of the cigarettes, and are redundant when used for presence detection only, by acquiring and processing a "complex" image, i.e. containing information which is of no use for presence detection purposes only.

[0007] US Patent No. 5,299,275 discloses a device comprising a boundle of optical fibers, which is used as a blur filter to limit high spatial frequencies incident upon an image sensor. Each optical fiber has a first end coupled to a lens and a second end coupled directly to a photosensitive surface of a CCD sensor. In the above known device, in order to obtain a blur filtering effect, the second end of each optical fiber is maintained separated by a given distance from the photosensitive surface of the CCD.sensor.

[0008] It is an object of the present invention to provide an optical presence detecting device designed to eliminate the aforementioned drawbacks, and which in particular is straightforward and cheap to produce. According to the present invention, there is provided a device for optically detecting the presence of at least one object, in particular a cigarette, the device comprising at least one optical fiber having a first end so located as to face, in use, said object, and a second end; a supporting body for supporting said optical fiber, the supporting body having a first and a second surface, and said second surface being a flat surface; a CCD sensor having a photosensitive surface; and an electronic control unit connected to the CCD sensor; the device being characterized in that said second end of the optical fiber is connected directly to said photosensitive surface of the CCD sensor; a portion of said second surface being defined by said second end of the optical fiber, and said second flat surface being parallel to, and in direct contact with, said photosensitive surface.

[0009] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a schematic view in perspective of a preferred embodiment of the device according to the invention;

Figure 2 shows a schematic, partially sectioned side view of Figure 1;

Figure 3 shows a schematic, larger-scale front view of a detail of the Figure 1 device;

Figure 4 shows views in perspective, with parts removed for clarity, of two variations of the Figure 1 device;

Figure 5 shows a view in perspective of one example application of the Figure 1 device;

Figure 6 shows a view in perspective of a further example application of the Figure 1 device.

[0010] Number 1 in Figures 1 and 2 indicates as a whole an optical presence detecting device comprising a substantially parallelepiped supporting body 2 having two parallel flat surfaces 3 and 4; a number of optical fibers 5 carried by supporting body 2 and each having an end 6 and an end 7; a CCD sensor 8 connected to supporting body 2 and having a flat photosensitive surface 9; and an electronic control unit 10 connected to CCD sensor 8 and communicating with an external monitoring unit 11 - normally a computer - over a cable lla.

[0011] As shown more clearly in Figure 2, ends 6 and 7 of optical fibers 5 are substantially flat and respectively define a portion of surface 3 and a portion of surface 4 of supporting body 2; and surface 4 of supporting body

2 is parallel to, and in direct contact with, photosensitive surface 9 of CCD sensor 8, so that end 7 of each optical fiber 5 is connected directly to CCD sensor 8.

[0012] As shown in Figure 3, photosensitive surface 9 of CCD sensor 8 comprises a grid 12 of pixels 13, and the end 7 of each optical fiber 5 directly contacts a respective group 14 of pixels 13.

[0013] Operation of device 1 will be described, for the sake of simplicity, with reference to one optical fiber 5 for optically detecting the presence, at a control station 15, of an object 16 guided by a conveying device 17 along a path P extending through station 15.

[0014] At control station 15, end 6 of optical fiber 5 is so located as to face object 16 traveling through station 15.

[0015] In actual use, optical fiber 5 transmits to end 7, and therefore directly to pixels 13 in respective group 14, the light impinging on end 6; and control unit 10 reads the brightness value picked up by pixels 13 in group 14, and determines, on the basis of said brightness value, whether end 6 of optical fiber 5 is or is not facing an object 16. More specifically, if not facing an object 16, end 6 receives a fairly large amount of light, so that the brightness value picked up by respective pixels 13 is above a first threshold value. Conversely, if facing, and hence shielded by, an object 16, end 6 receives a fairly small amount of light, so that the brightness value picked up by respective pixels 13 is below a second threshold value.

[0016] In an alternative embodiment, control unit 10 may use one threshold to determine the presence or absence of an object 16 opposite end 6 of optical fiber 5.

[0017] In yet a further embodiment, unit 10 may read the brightness picked up by only a portion 18 of pixels 13 in group 14 - typically the central portion, as shown in Figure 3. Not reading the outer pixels 13 provides for eliminating any errors caused by incorrect positioning of optical fibers 5 with respect to photosensitive surface 9, in which case, the outer pixels 13 may not be connected correctly to end 7 of optical fiber 5.

[0018] As shown in Figures 1 and 4a, device 1 may comprise a number of optical fibers 5 with respective ends 6 arranged at control station 15 in a given geometrical configuration. This embodiment provides for simultaneously detecting the presence of a number of objects 16 traveling in a group arranged in said geometrical configuration, by each object 16 being positioned, in use, facing end 6 of a respective optical fiber 5.

[0019] In a further embodiment shown in Figure 4b, detecting device 1 comprises a number of successive control stations 15 located along the path P of object 16 (or group of objects 16); and the end 6 of an optical fiber 5 is so located at each control station 15 as to face the object 16 traveling through control station 15. This embodiment is normally used to determine the travel of object 16 along path P.

[0020] In further embodiments shown in Figures 4a and 4b, supporting body 2 may be divided into a body 2a having surface 3 defined partially by ends 6 of optical fibers 5, and a body 2b separate from body 2a and having surface 4 defined partially by ends 7 of optical fibers 5 and connected to photosensitive surface 9 of CCD sensor 8. The distance between bodies 2a and 2b is limited solely by the light transmitting capacity of optical fibers 5. In yet a further embodiment (not shown), ends 6 of optical fibers 5 are carried by a number of respective independent bodies 2a.

[0021] In yet a further embodiment (not shown), each optical fiber 5 comprises a bundle of elementary optical fibers.

[0022] As stated, device 1 as described may be used to advantage in the cigarette packing industry, and in particular for detecting the presence of cigarettes 19.

[0023] Figure 5 shows a number of cigarettes 19 arranged, in known manner not shown, in an orderly group 20, which is fed along path P by a known conveyor 21 extending through station 15, where supporting body 2 is positioned with surface 3 parallel to path P; and surface 3 is defined partially by ends 6 of a group of optical fibers 5 arranged in the same geometrical configuration as cigarettes 19 in group 20.

[0024] As a group 20 traveling along path P reaches control station 15, monitoring unit 11, via cable 11a, interrogates unit 10, which, after determining the brightness threshold of each group 14 of pixels 13, supplies monitoring unit 11 with a response indicating the presence or absence of each cigarette 19 associated with a respective optical fiber 5.

[0025] As shown in Figure 6, besides detecting groups 20 of cigarettes 19, detecting device 1 may also be used to advantage for detecting the presence of cigarettes 19 inside the channels 22 of a cigarette hopper 23.

[0026] Figure 6 shows a mass 24 of cigarettes 19, which are fed by gravity along a path P defined by channels 22, and along which is located a control station 15 of a detecting device 1 of the type described above.

[0027] Via cable 11a, monitoring unit 11 provides for cyclically interrogating unit 10, which, after determining the brightness threshold of each group 14 of pixels 13, supplies unit 11 with a response indicating the presence or absence of each cigarette 19 associated with a respective optical fiber 5.

[0028] Cable 11a between units 10 and 11 is preferably a serial cable operating according to a standard IBM 2848 protocol.

Claims

1. A device for optically detecting the presence of at least one object, in particular a cigarette, the device comprising at least one optical fiber (5) having a first (6) and a second (7) end; a CCD sensor (8) having a photosensitive surface (9); and an electronic control unit (10) connected to the CCD sensor (8); said

first end (6) being so located as to face, in use, said object (16); and the device being characterized by said second end (7) of the optical fiber (5) being connected directly to said photosensitive surface (9) of the CCD sensor (8).

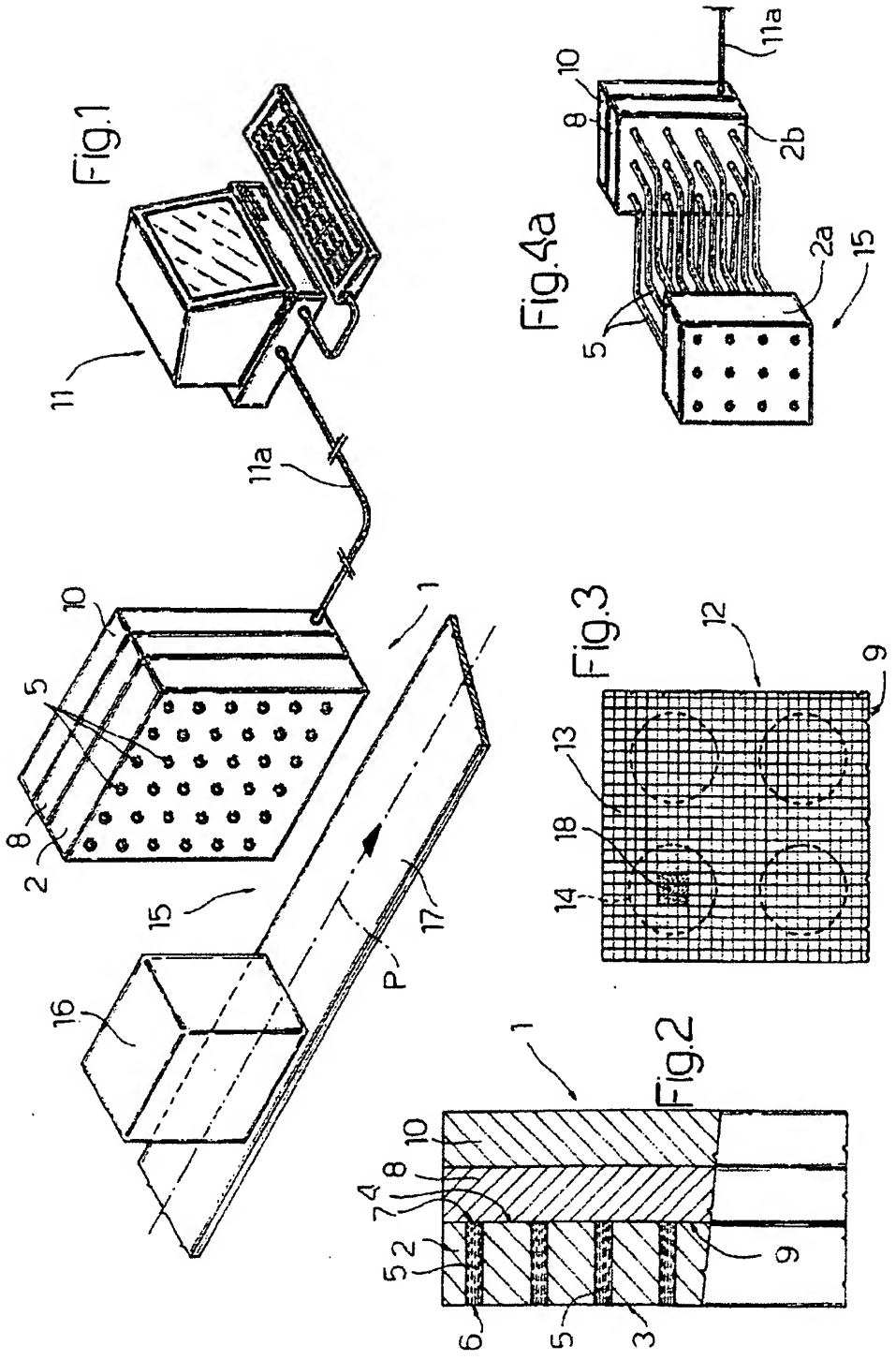
2. A device as claimed in Claim 1, comprising a supporting body (2) for supporting said second end (7) of the optical fiber (5); said supporting body (2) having a flat surface (4), a portion of which is defined by the second end (7); said flat surface (4) being parallel to, and in direct contact with, said photosensitive surface (9).

3. A device as claimed in Claim 1, comprising a supporting body (2) for supporting said optical fiber (5) said supporting body (2) having a first flat surface (3), a portion of which is defined by said first end (6) of the optical fiber (5), and a second flat surface (4), a portion of which is defined by said second end (7) of the optical fiber (5); the second flat surface (4) being parallel to, and in direct contact with, said photosensitive surface (9).

4. A device as claimed in any one of Claims 1 to 3, comprising guide means (17) for guiding said object (16) along a path (P); and a control station (15) located along said path (P); said first end (6) of the optical fiber (5) being located at the control station (15).

5. A device as claimed in any one of Claims 1 to 3, comprising guide means (17) for guiding said object (16) along a path (P); and at least two control stations (15) located along said path (P); each said control station (15) being associated with a first end (6) of at least one said optical fiber (5).

6. A device as claimed in any one of Claims 1 to 5, comprising a number of said optical fibers (5), said first ends (6) of which are arranged in a first group in a given geometric configuration to detect a second group (20) of objects (19) arranged in said geometric configuration.



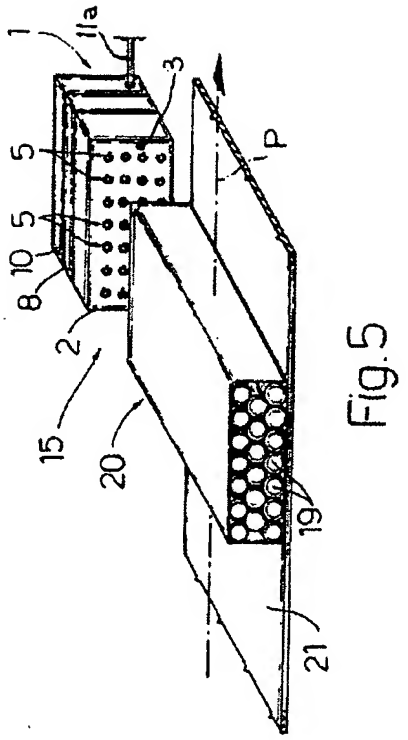


Fig.5

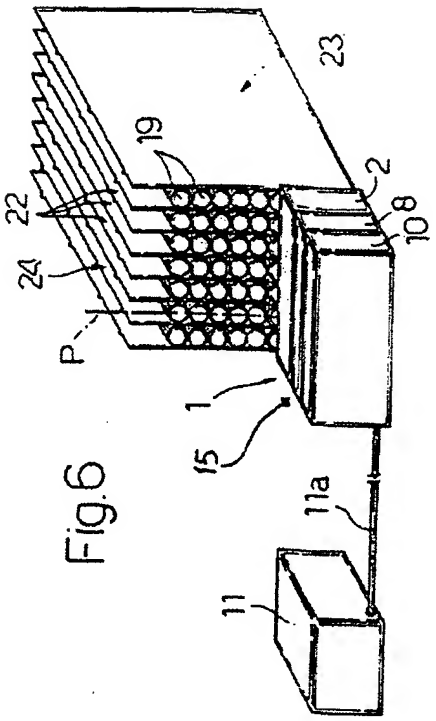


Fig.6

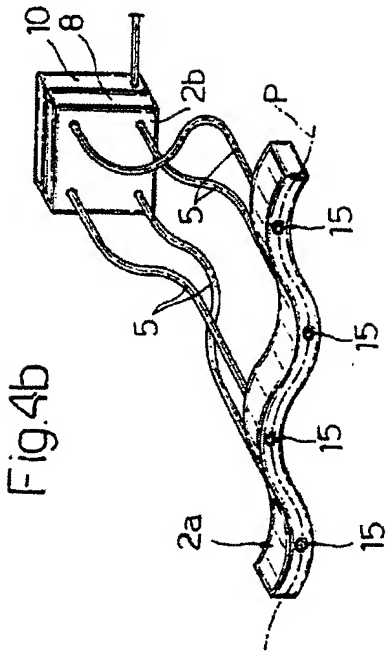


Fig.4b

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EUROPEAN SEARCH REPORT

Application Number
EP 99 10 2616

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	25 May 1999	Jagusiak, A

CATEGORY OF CITED DOCUMENTS

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